PHYSICAL AND FUNCTIONAL PERFORMANCE OF THE TELECOMMUNICATION INFRASTRUCTURE AFTER THE CANTERBURY EARTHQUAKE SEQUENCE

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Project Motivation

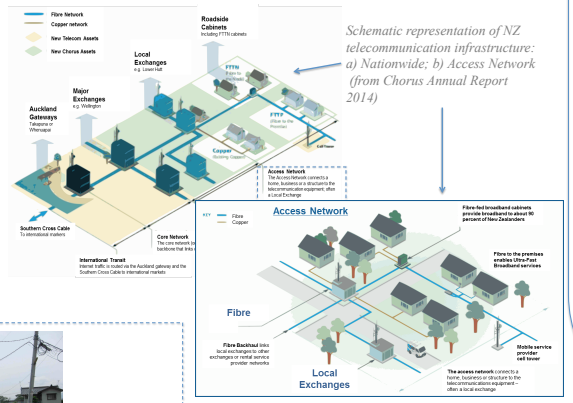
The operation of telecommunication networks is critical during business as usual times, and becomes most vital in post-disaster scenarios, when the services are most needed for restoring other critical lifelines, due to inherent interdependencies, and for supporting emergency and relief management tasks. In spite of the recognized critical importance, the assessment of the seismic performance for the telecommunication infrastructure appears to be underrepresented in the literature.

The **FP6 QuakeCoRE project** *"Performance of the Telecommunication Network during the Canterbury Earthquake Sequence"* will provide a critical contribution to bridge this gap.

Thanks to an unprecedented collaboration between national and international researchers and highly experienced asset managers from Chorus, data and evidences on the physical and functional performance of the telecommunication network after the Canterbury Earthquakes 2010-2011 have been collected and collated. The data will be processed and interpreted aiming to reveal fragilities and resilience of the telecommunication networks to seismic events

Telecommunication Infrastructure

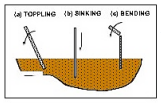
The telecommunication infrastructure comprises **two main networks** including the *landline* and *broadband data service network*, and the wireless cellular service network, that are linked together by means of data interoperability and transmission exchanges. Each network is made of **different components** including among others, *underground cables, access pits, roadside cabinets, overhead lines and poles, cellular towers, exchange facilities*.



Schematic representation of NZ telecommunication infrastructure: a) Nationwide; b) Access Network (from Chorus Annual Report 2014)

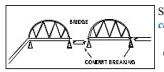
Earthquake-induced Physical and Functional Impacts: Examples

Examples of Physical Impacts on Components



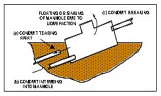
Damage mechanisms of *aerial poles*: a) toppling; b) sinking; c) bending

Damaged poles due to lateral ground spreading *(courtesy of Alex Tang, 2008)*



Schematic of *damage to cables at bridge link*

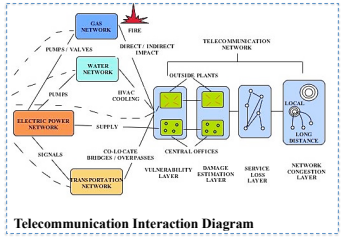
Cables severed due to collapse of bridge deck *(courtesy of Alex Tang, 2008)*



Damage due to conduit/ manhole deformations: a) conduit tearing away; b) conduit crushing into manhole; c) conduit breaking. *(courtesy of Alex Tang, 2008)*

Cable cut due to lateral ground spreading. *(courtesy of Alex Tang, 2010)*

Liquefaction in ducts within a manhole *(courtesy of Chorus)*



Telecommunication Interaction Diagram

Achieved Outcomes

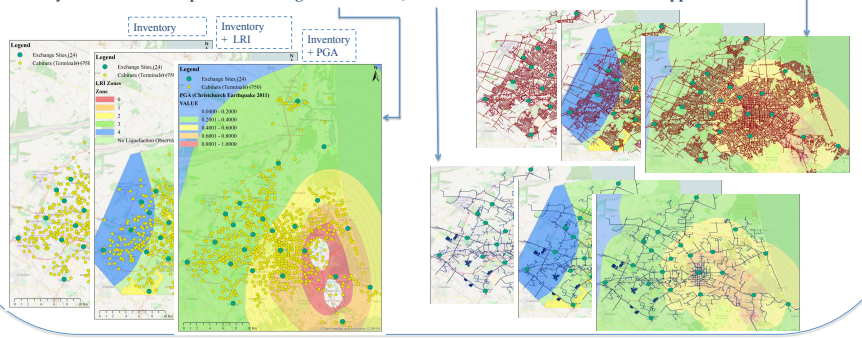
Definition of Taxonomies and Data Collection

Identification of vulnerable components and critical components to system functionality. Proposal of an ad-hoc taxonomy.
Data collection: components' location and characteristics; location and description of earthquake-induced faults and repair activities

Components	Data Collection Progress	Data Description
Exchange Buildings	☑	GIS location of buildings; Site inspection observations from the Canterbury Earthquakes.
Buried Cables	☑	GIS layout of Copper and Fibre networks; Cable faults from the Canterbury Earthquakes *(fault type, cable type, location, cost, etc.).*
Roadside Cabinets	☑	GIS locations of cabinets
Access pits to buried cables (vaults / manholes)	☑	Manholes and Ducts investigation observations from the Canterbury Earthquakes *(Material, Size, Damage type, Damage cost, status, Inspection observations, etc.)*
Aerial cables & Poles	☒	☒
Cellular Towers	☒	☒
SCADA Equipment	☒	☒

Data Processing

- GIS overlays have been developed for **Exchanges & Cabinets**, **Buried Fibre network** and **Buried Copper network**.



Next Steps and Expected Outcomes

- Fragility curves/indexes for cables and above-ground components
- Identifications of functional impacts, interdependencies
- Identifications of resilient element and strategies

Acknowledgements

The financial support of *QuakeCoRE* is gratefully acknowledged

The interest and support of *ReLUIS* to test the transferability and applicability of the project's outcomes to overaseas telecommunication infrastructures is gratefully acknowledged

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